Appendix A.

Fortescue Metals Group Solomon Project: Regional Subterranean Fauna Survey: Final Report

Subterranean Ecology Pty Ltd

Scientific Environmental Services

Fortescue Metals Group

Solomon Project:

Regional Subterranean Fauna Survey

Prepared for: Fortescue Metals Group
February 2011

Fortescue Metals Group
Solomon Project:
Regional Subterranean Fauna Survey

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Subterranean Ecology Pty Ltd
Scientific Environmental Services
ABN 91 131 924 037
Suite 8, 37 Cedric St
STIRLING
Western Australia
Email: info@subterraneanecology.com.au
www.subterraneanecology.com.au

Report No. 2010/ 20

COVER: Stygofauna Amphipod: ***Nedsia* n. sp. SOLOMON 1** recorded both from Solomon Kings deposits and from Regional survey. Photo Copyright Subterranean Ecology.

LIMITATIONS: This survey was limited to the requirements specified by the client and the extent of information made available to the consultant at the time of undertaking the work. Information not made available to this study, or which subsequently becomes available may alter the conclusions made herein.

VERSION No.	PREPARED BY	REVISED BY	RECIPIENT	DATE
Rev A, B	M Weerheim	S Eberhard		20 Dec 2010
Rev C, D, E	M Weerheim	S Callan, S Danti		07 Jan 2011
Rev F, G	M Weerheim	S Eberhard, K. Eriksson	Shaun Grein, FMG	2/03/2011
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Executive Summary

Fortescue Metals Group Limited (Fortescue) proposes to develop the Solomon Project (the Project), in the Pilbara region of WA approximately 60 km north of Tom Price. The Project includes rail and road infrastructure, and the development of new iron ore mine sites at the Firetail and Kings deposits. Subterranean fauna were identified as an environmental factor for consideration at both deposits. Baseline Surveys for subterranean fauna were undertaken during 2010 and the findings were submitted towards the Public Environmental Review (PER) of the Project.

The Baseline Surveys identified the presence of diverse stygofauna and troglofauna in the Project area. In the Kings deposits, 22 stygofauna species (revised from 19 previously) and 27 troglofauna species (revised from 23 previously) were identified, of which 10 stygofauna and 17 troglofauna species were only known from inside the Kings impact areas. In the Firetail deposits, 45 species of troglofauna were identified with ten species recorded only from within impact areas (Firetail or Kings).

The Baseline Surveys at Kings and Firetail recorded relatively high proportions of shared species between deposits suggesting considerable habitat connectivity (Subterranean Ecology 2010; Bennelongia 2010). Of the 45 troglofauna species recorded at Firetail, 16 species were common to both Firetail North and Firetail South (36%), while at Kings, 48% of troglofauna species were common over two or more deposits (Valley of Queens, Trinity, Valley of Kings, Zion). At least nine troglofauna species (provisionally 19 species pending further taxonomic study) are shared between the Kings and Firetail areas, indicating habitat connectivity between the differing geologies of Channel Iron Deposit (CID), Detrital Iron Deposit (DID) and Banded Iron Formation (BIF).

To provide regional context for the assessment of potential impacts to stygofauna and troglofauna in relation to the Project, Subterranean Ecology was commissioned to undertake a Regional Subterranean Fauna Survey. The Regional Subterranean Fauna Survey aimed to improve understanding of the occurrence and distribution of subterranean species outside of the Solomon impact areas.

The Regional Survey sampled seven reference areas situated in similar geological and/or hydrological settings within 25 km of the Kings and Firetail deposits, including Castle Camp, Mt Florence, Sheila Valley East and West, Serenity, Kangeenareena Creek, and Weelamurra Creek. The Regional Survey comprised two field trips, in October and December 2010, during which 149 samples were collected from 72 sites using a combination of net hauling, pumping, scraping, trapping and Karaman methods. Twenty-two (22) species of stygofauna and 14 species of troglofauna were collected, of which nine stygofauna and five troglofauna species had been recorded during the 2010 Baseline Survey of Kings. The Regional Survey did not detect any of the troglofauna species recorded during the 2010 Baseline Survey of Firetail.

Invertebrate ecological communities typically comprise a few species that are abundant and a majority of species occurring in low numbers. Pilbara subterranean communities are no exception to this general natural pattern. For biological surveys, this means it is difficult to detect most of the rare species in a community, and almost impossible to collect all species in the course of one or even several surveys. In the case of follow-up surveys, it is also difficult to re-collect the rare species.

Considering these general survey limitations, and other site-specific geographic, geologic and climatic constraints, the Solomon Regional Survey established that at least 82% of stygofauna and 36% of troglofauna species occur outside the Kings impact area.
The Regional Survey sampling results support the conclusion made in the Kings Baseline Survey, that it is probable that species of subterranean fauna collected in the Kings CID and Firetail DID and BIF deposits will also be found to occur outside the proposed mine impact zones, in suitable porous geological strata and connected hydrologic catchments.

Currently four species of stygofauna and 17 species of troglofauna are known only from inside the Kings impact area, and nine species of troglofauna are known only from inside the Firetail impact area. Considering that the majority of the Kings stygofauna assemblage is known from outside impact areas it is considered likely that the other four species also occur outside.

For troglofauna, the proportion of shared species between deposits, and nearby regional areas with similar geology is considered likely to increase with further taxonomic study and field survey. Still, the possible existence of locally restricted SRE species cannot be discounted and determining the distribution range of all potential SRE species will be difficult owing to practical limitations in sampling subterranean fauna.

The proportion of troglofauna currently only known from inside the proposed Kings mine prospects (62%) is relatively high compared with the proposed Firetail mine pits (9%), and other developments where approval to mine has been obtained (eg. 4 to 25%) (Bennelongia 2010). The high disparity in proportions at Kings is related to the absence of any reference sites available for sampling in the CID at Valley of Queens, Trinity, Valley of Kings, and Zion, where the proposed mine plan involves complete removal of the CID.

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1 INTRODUCTION

Fortescue Metals Group (Fortescue) proposes to develop the Solomon Project which is located in the Hamersley Ranges, central Pilbara region of Western Australia (Figure 1). The project involves the construction of mine sites and associated road and rail infrastructure at the Kings and Firetail deposits which are located approximately 60 km north of Tom Price.

The Kings deposits consist of Channel Iron Deposits (CID) and include four contiguous tenements known as the Valley of the Queens, Trinity, Valley of the Kings and Zion.). The Firetail deposits consist of Bedded and Detrital Iron Deposits (BID and DID) and have been divided into Firetail North and Firetail South.

For the purpose of establishing the presence and diversity of any subterranean fauna that may be present, surveys in the Kings and Firetail deposits were initially limited to the areas of mining interest. These surveys identified the presence of diverse stygofauna and troglofauna in the Project area (Subterranean Ecology 2010; Bennelongia 2010).

To provide regional context for the assessment of potential impacts to stygofauna and troglofauna in relation to the Project, Subterranean Ecology was commissioned to undertake a Regional Subterranean Fauna Survey (hereafter Regional Survey). The Regional Survey aimed to enhance regional knowledge of subterranean fauna in the Solomon area, and to assess the distributions of stygofauna and troglofauna species outside of the impact areas for the Project.

1.1 RELEVANT LEGISLATION

The Survey was undertaken to meet the EPA's requirements of an Environmental Impact Assessment of subterranean invertebrates and complied with:

- Guidance Statement 54: Consideration of Subterranean Fauna in Groundwater and Caves during Environmental Impact Assessment in Western Australia, (EPA 2003)
- Guidance statement 54a: Sampling Methods and Survey Considerations for Subterranean Fauna in Western Australia (EPA 2007)
- Wildlife Conservation Act 1950 (State)
- Environment Protection and Biodiversity Conservation Act 1999 (Federal)

1.2 PROJECT OVERVIEW

The Solomon project is situated within the Hamersley subregion of the Pilbara Bioregion (Figure 1). The landscape is comprised of steep hills and ridges, incised drainage channels and alluvial fans that form part of the South Fortescue River catchment.

The Regional Survey focused on seven study areas located within 25 km from the Kings deposits (Table 1). Regional study areas were selected on the basis of having similar geology to the Project area (predominantly CID, DID, BIF and alluvium) and/or being part of the same hydrogeological system.

Table 1 Solomon Regional Survey areas.

Area Name	Distance to Kings	Relevance
Castle Camp	6 km S	Similar geology as Kings deposits; drains into Trinity and Valley of Queens deposits
Sheila Valley East	10 km SW	Similar geology as Kings; part of Weelamurra Creek system
Sheila Valley West	18 km SW	Similar geology as Kings; part of Weelamurra Creek system
Mt Florance Pastoral Station	10 km NE	Downstream catchment of Kangeenareena Creek; receives drainage from Valley of Kings, Firetail and Zion deposits
Serenity	25 km W	Similar geology to Kings, drains into Weelamurra Creek
Kangeenareena Creek	runs N	Downstream catchment of Trinity deposit
Weelamurra Creek	runs W	Downstream catchment of Valley of Queens

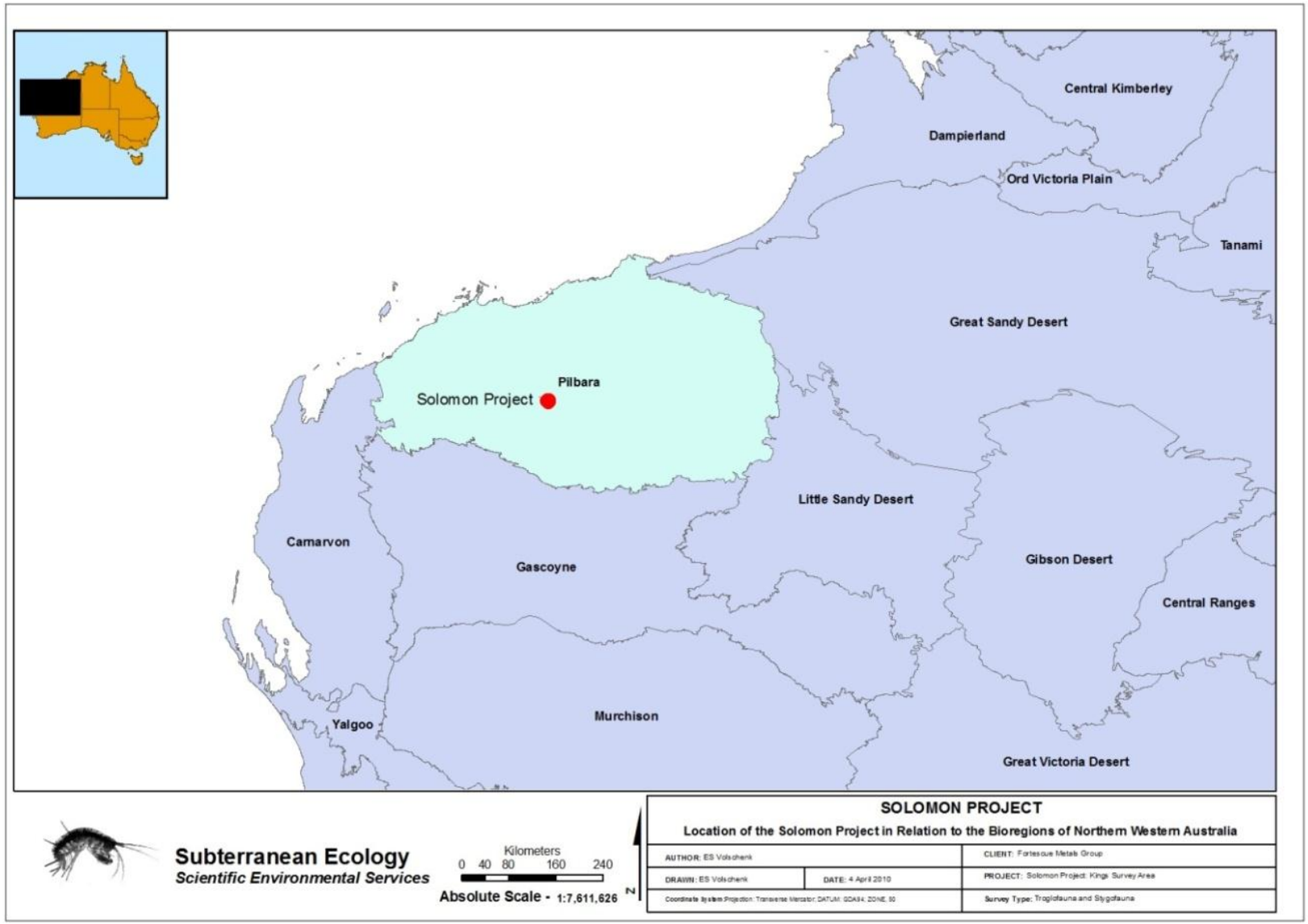


Figure 1 Location of the Solomon Project Area in the Pilbara bioregion of Western Australia IBRA

1.3 SUBTERRANEAN FAUNA: TROGLOFAUNA AND STYGOFAUNA

Troglofauna are animals inhabiting air-filled caves or smaller cavities below the ground. They are classified into:

- **Troglophiles** - species that facultatively use the air filled subterranean voids but are also found in similar microhabitats on the surface and which can complete their life-cycles either underground or in surface habitats;
- **Trogloxenes** - species that regularly enter caves and that require caves for particular activities, but which are unable to live their entire lives in subterranean habitats;
- **Troglobites** - species that are obligatory inhabitants of subterranean habitats. These species often show distinct morphological adaptations to life in a permanently dark and humid environment, including a lack or reduction of eyes, wings and cuticle thickness, depigmentation, as well as elongation of appendages. Additional changes to physiology and behaviour are also usually present (Christiansen 1992, 2005).

Stygofauna are aquatic animals that live in groundwater. **Stygophiles**, **stygoxenes** and **stygobites** are classified in a similar way to troglofauna, except that the habitat is comprised of water-filled subterranean voids (Gibert *et al.* 1994; Howarth 1983; Humphreys 2000; Poulson and Lavoie 2000).

Nutrient and energy resources for subterranean habitats are almost entirely allochthonous *i.e.* originating from surface environments, transported into subterranean systems by tree roots, water and, in the case of larger caves, by animals (Howarth 1983; Humphreys 2000; Poulson and Lavoie 2000).

Subterranean habitats are often spatially constrained by the specific geology in which they have developed (Harvey 2002; Howarth 1983; Humphreys 2000). Troglobites often have distributions constrained to the limits of the habitats in which they have evolved and can therefore be defined as Short-Range Endemics (SRE's) (Harvey 2002; Ponder and Colgan 2002). Harvey (2002) considered species with distributions of less than 10,000 square kilometres as SRE's; but most troglobites have distributions that are significantly less. Eberhard *et al*. (2009) suggested 1,000 square kilometres may be a more appropriate range criterion for SRE subterranean fauna in the Pilbara. Once a species has developed significant specialization to subterranean life, it is unlikely to be able to persist on the surface and, for this reason, most troglobitic species are unable to disperse from the subterranean habitats in which they have evolved (Holsinger 2000).

In Western Australia, and particularly in the Pilbara region, there has been a recent renaissance in the study of subterranean biodiversity (Humphreys 2008) driven by the growth of the mineral resources industry and relevant legislative regulations EIA (Environmental Protection Authority (EPA) 2003; EPA 2007). Despite this, relatively little knowledge of regional subterranean biodiversity has emerged from the published literature (Eberhard *et al.* 2005; Edward and Harvey 2008; Finston *et al.* 2008; Finston 2006; Harvey *et al.* 2008; Harvey and Volschenk 2007; Karanovic 2007; Page *et al.* 2008; Sungwon and Cho 2009; 2008). Most of the subterranean fauna species collected from the Pilbara are undescribed new species and knowledge of their ecology and biology is limited. Apart from the two recent surveys of the Kings (Subterranean Ecology 2010) and Firetail deposits (Bennelongia 2010), the Solomon project area has been subjected to limited subterranean field surveys.

2 METHODS

2.1 SAMPLING METHODS

The Solomon Regional Survey comprised two consecutive field trips, which took place from 4th to 8th October 2010 and from 7th to 13th December 2010. Both field trips used a combination of below sampling methods to improve capture rates.

Sampling methods used in the first field trip were:

- Combined haul and scrape sampling of bores
- Pump sieving
- Karaman sampling
- Deployment of troglofauna traps

Sampling methods used in the second field trip were:

- Combined haul and scrape sampling of bores
- Pump sieving
- Karaman sampling
- Retrieval of troglofauna traps

The Sampling methods conform to the Western Australian Environmental Protection Authority (EPA) Guidance Statements for subterranean fauna, No. 54 (Envronmental Protection Authority (EPA) 2003)and 54a (EPA 2007), and the Department of Environment and Conservation (DEC) Stygofauna Sampling Protocol (Eberhard *et al.* 2004).

2.1.1 Combined haul and scrape sampling

Boreholes were sampled for troglofauna and stygofauna using plankton nets (100 mm diameter; 50 µm mesh). Each net was fitted with a weight (lead fishing sinker) and a 35 ml sample vial. A scraping attachment was attached above each net. The scraping attachment comprised of numerous strands of fishing line extending approximately 10 cm from a central point so that they were perpendicular to the main line to which the net was attached. The attachment was used to gently agitate the sides of the bore directly above the net to disturb any troglofauna clinging to the bore wall. On each haul, the net was lowered into the bore until it reached the bottom of the bore, raised and lowered several times to disturb bottom sediments, and then retrieved through the water column if the bore contained water. Each bore was sampled once per field trip. Each sample comprised of six hauls for bores that contained water and four hauls for bores that were dry. All hauls were consolidated in a large jug, elutriated and transferred into a labelled vial to produce a single sample. Samples were preserved in chilled 100% ethanol to preserve DNA.

2.1.2 Pump sieving

Selected bore holes that had pumps installed allowed for opportunistic pump sieving (APPENDIX A). Pump sieving involved attaching a 50 µm mesh net to the flow outlet and then retrieving the netseveral hours to several days later. Contents of the net were transferred into a labelled vial and preserved in 100% ethanol.

2.1.3 Karaman sampling

The Karaman method was employed at spring-brooks where groundwater discharges to the surface in springs. Two locations, Kangeenareena Spring and Weelamurra Spring, were sampled during both field trips (
Table 2, APPENDIX A). Karaman sampling involved digging a pit until the water level was reached and water began flowing into the hole. Incoming water was bailed out with a jug and poured through a 50 µm net. Contents of the net were transferred into a labelled vial and preserved in 100% ethanol.

2.1.4 Troglofauna trap sampling

This method involved the deployment of troglofauna traps within bores. Each trap comprised of a PVC cylinder approximately 15 cm long and 50 mm diameter. The bottom of the cylinder was capped with a PVC end-cap through which a 5mm hole was drilled to permit drainage of water. The top was covered with a coarse grid to allow the invertebrates access into the trap. A trap containing moist, sterilised decaying leaf was deployed per bore. Each trap was lowered into the bore until it made contact with the bottom of the bore or, more usually, with the water table; thereafter it was lifted approximately 3 metres and tied off. The bores were closed using concrete bore plugs, and left for a period of approximately eight weeks to allow the traps to become colonized. Traps were deployed in 39 bores during the first field trip; of these, 29 bores had one trap deployed, while 10 deep bores had three traps deployed above each other in order to sample at different depths. Trap samples were retrieved during the second field trip.

2.1.5 Sample curation

In an effort to maximize DNA sequence recovery from specimens, samples obtained from scraping and hauling were transferred immediately into a cooler box filled with ice and moved to a refrigerator set to approximately 2°C the same day. Samples were stored at 2°C throughout study.

2.2 SAMPLE SITES AND SURVEY EFFORT

The Solomon Regional Subterranean Fauna Survey sampled seven reference areas situated in similar geological and/or hydrological settings within 25 km of the Kings and Firetail deposits, including Castle Camp, Mt Florence, Sheila Valley East and West, Serenity, Kangeenareena Creek, and Weelamurra Creek (Figures 2 and 3). A combined total of 149 samples were collected from 72 survey sites. Sixty-one of these sites were sampled in the first field trip. Due to rehabilitation, inaccessibility or bore collapse, 14 of these sites could not be re-sampled during the second field trip. To compensate for this, 11 additional survey sites were sampled in the second field trip, yielding a total of 58 sites sampled in this trip.

In the first field trip 58 samples were collected, comprising 49 scrape and haul samples, 7 pump samples and 2 Karaman samples. In the second field trip 91 samples were collected, comprising 37 trap samples, 47 scrape and haul samples, 5 pump samples and 2 Karaman samples (

Table 2).

Table 2 Breakdown of survey effort during first and second field trip.

	Field trip 1			Field trip 2			
Survey Area	Scrape / Haul	Pump	Karaman	Trap	Scrape / Haul	Pump	Karaman
Castle Camp	9			8	8		
Kangeenareena Creek			1				1
Mt Florance Pastoral	1	4			1	4	
Serenity	3	1			3		
Sheila Valley East	16	1		15	19		
Sheila Valley West	16			14	15		
Weelamurra Creek	4	1	1		1	1	1
Total samples collected	49	7	2	37	47	5	2
Grand total	58			91			

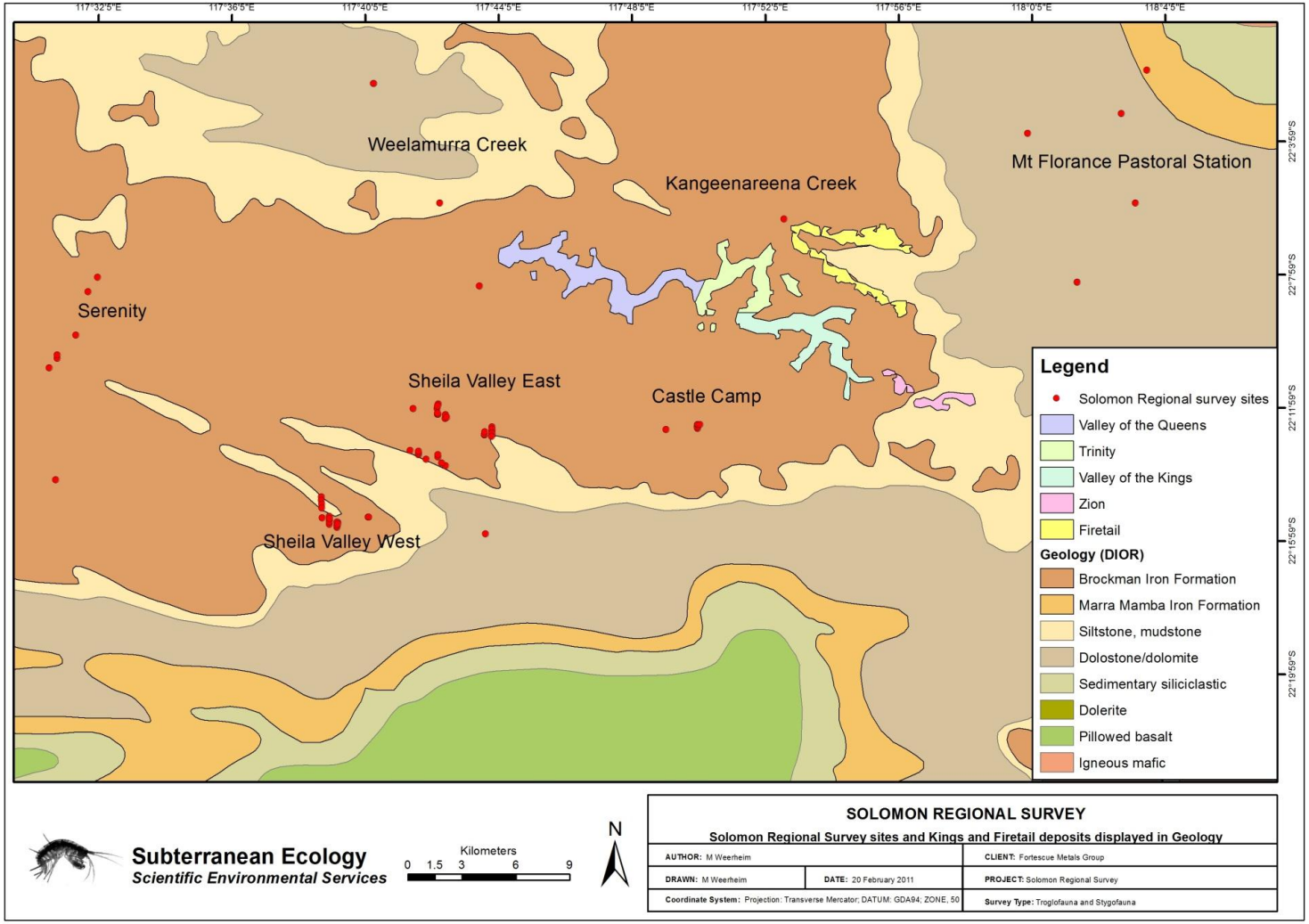


Figure 2 Regional survey sites, Kings and Firetail deposits, and simplified basement geology.

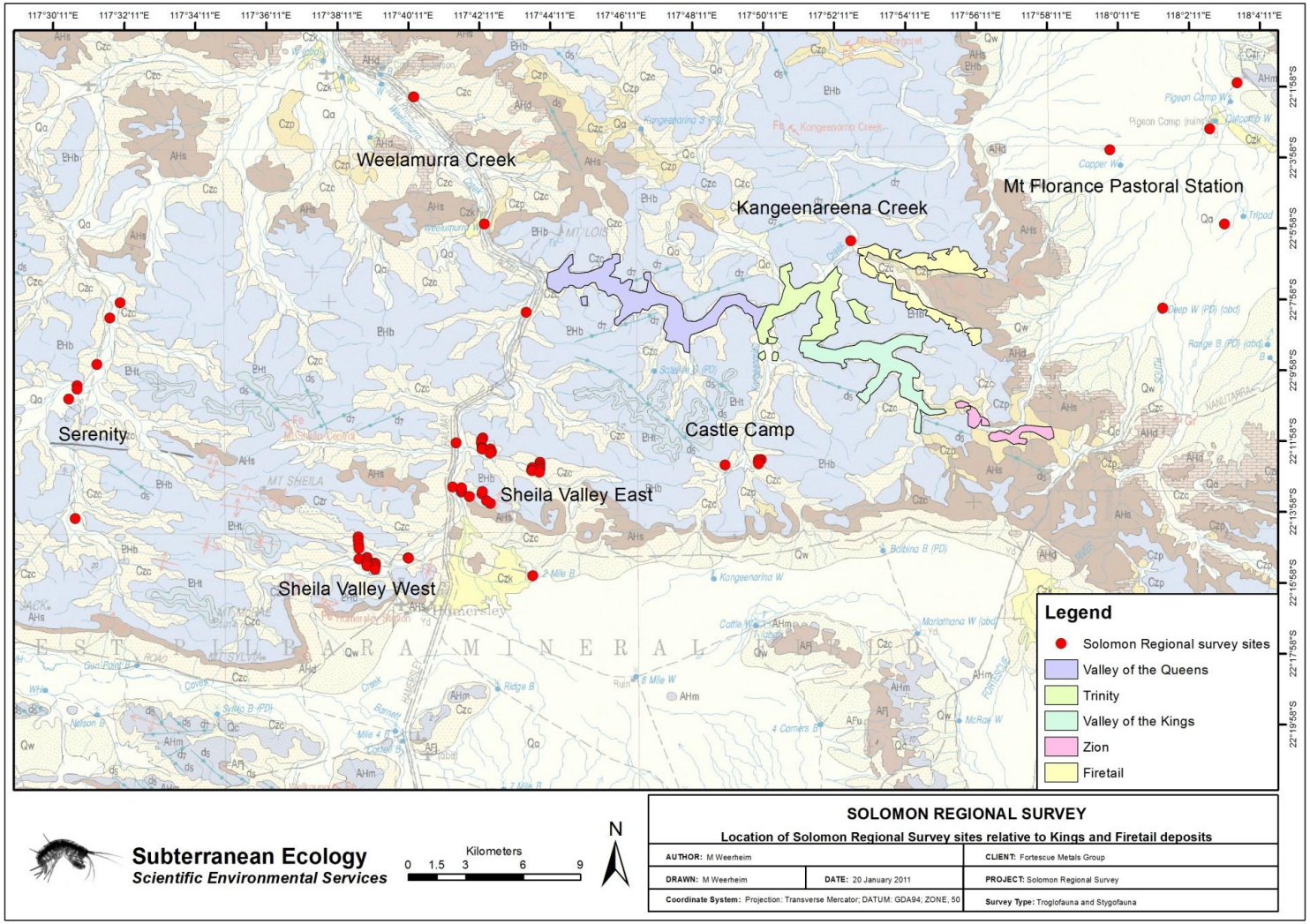


Figure 3 Solomon Regional survey sites, Kings and Firetail deposits, in relation to surficial geology and drainage (Thorne *et al.* 1996).

2.3 SPECIES IDENTIFICATION

Sorting of samples occurred in the laboratory using dissecting microscopes. Each taxon was identified to the lowest taxonomic rank possible using published keys and descriptions, and its abundance also recorded. Identification of microfauna and macrofauna used a Leica® DM2500 compound microscope. High resolution images were taken with a Leica® M205C Stereo Dissection Microscope; DFC420 Camera and Leica® LAS Image capturing Software.

New and undescribed species, identified on the basis of morphological characters, were given morpho-species names. Morpho-species are species distinguished from others only by observable morphology. Morpho-species names are typically used during parataxonomic sorting, for specimens in unsuitable condition for the observation of species level characters, or for organisms where the current state of taxonomic knowledge is insufficient or unknown.

Voucher specimens were photographed and retained in Subterranean Ecology's voucher collection. All remaining specimens will be lodged at the Western Australian Museum. Identifications were confirmed by specialist taxonomists where expertise was available. Taxonomic alignments with morpho-species collected at Firetail with those of the Kings and Regional surveys were undertaken with assistance from Ms Jane McRae (Bennelongia Environmental Consultants).

2.4 MOLECULAR GENETIC ANALYSES

Genetic sequencing of the mitochondrial gene cytochrome oxidase subunit 1(COI) was undertaken to investigate species distribution between Kings and Regional areas. COI is routinely used to detect and explore species boundaries (genetic species) in groups of organisms for which the taxonomy is poorly defined or poorly known. In the absence of COI (occasionally sequencing of this gene is unsuccessful) ribosomal genes, such as the 12S gene, may also be used. Gene sequencing and analyses were conducted by Helix Molecular Solutions (www.helixsolutions.com.au).

A total of 29 samples from 14 taxonomic groups (10 stygofauna, 4 troglofauna) were sequenced for the COI gene. Twenty-four of these samples were of specimens collected in the first field trip of the Solomon Regional survey , while an additional five samples were of specimens previously collected from the Kings deposits (Subterranean Ecology 2010).

2.5 CONSTRAINTS AND LIMITATIONS

The ecology and habitat characteristics of subterranean fauna provide some challenges. The conditions in bore holes are not always representative of the wider subterranean habitat (Hahn and Matzke 2005), and many subterranean species may be rare, and difficult to detect. Because of this, results between sampling trips (even at the same bores) can be highly unpredictable. Species identifications are provisional on information available at the time of writing, and may be adjusted in the future as specialist taxonomy identifications and DNA results become available.

3 RESULTS

3.1 SAMPLING EFFICIENCY

Subterranean Fauna "Strike" Rates

The "strike" rate is the proportions of sites yielding subterranean fauna. All seven Regional study areas surveyed yielded stygofauna. Five of the Regional study areas yielded troglofauna, those who did not yield troglofauna were Mt Florance Pastoral Station (saturated calcrete and cased bores so troglofauna sampling not possible), and Kangeenareena Creek (Karaman site for aquatic fauna only).

Total survey – 71 sites sampled
40 sites yielded subterranean fauna = 56%
29 sites yielded stygofauna = 41%
15 sites yielded troglofauna = 21%

Trip 1 – 61 sites sampled
29 sites yielded subterranean fauna = 48%
24 sites yielded stygofauna = 39%
6 sites yielded troglofauna = 10%

Trip 2 – 58 sites sampled
30 sites yielded subterranean fauna = 52%
22 sites yielded stygofauna = 38%
11 sites yielded troglofauna = 19%

Troglofauna capture rates

Total samples taken over entire survey = 149, Trip 1= 58 samples, Trip 2= 91 samples.
Total troglofauna specimens captured = 58, Trip 1= 8 spms, Trip 2= 50 smps.
Hence, capture rates were:
Entire survey: 0.39 specimens per sample
Trip 1: 0.14 specimens per sample
Trip 2: 0.55 specimens per sample

3.2 STYGOFAUNA

Twenty-five species of stygofauna were collected from 28 Regional sampling sites. The majority of species were represented by ten or more individuals, with four taxa collected in high abundance (>100 individuals) (Figure 4).

The Regional Survey collected representatives of characteristic Pilbara stygofauna, such as amphipods (5 species), copepods (2 species), crustaceans (7 species), isopods (3 species), oligochaetes (5 species), ostracods (1 taxa) and one species of water mite. Ostracods found in the Solomon King Survey area have been found to belong to widespread species by specialist taxonomists. Due to this, ostracods collected in the Regional Survey were not identified to species level.

Species relevant to the impact assessment for the Kings deposits are presented in Table 3, while the complete list of stygofauna species recorded from both Kings and Regional sites is presented in APPENDIX B. No stygofauna species were found in the Firetail deposits that aligned with species from the Kings or Regional Survey. Because dewatering is not planned at Firetail, stygofauna sampling was not a focus of the assessment here; however one species of Bathynellidae was collected as by-catch during troglofauna sampling. This species was different to the Bathynellidae collected from Kings (Bennelongia 2010; J. McRae pers. comm.), and Regional Survey sites.

Of the 25 species of stygofauna recorded from Regional sites, nine (36%) had been previously recorded from the Solomon Kings deposits (Table 3). The Baseline Survey of the Kings deposits (Subterranean Ecology 2010) recorded 22 species of stygofauna, of which ten species were at that time only known from inside of the Kings impact area, however six of these species were also collected in the Regional Survey. To date, four stygofauna species remain that are currently known only from inside potential impact areas at Kings.

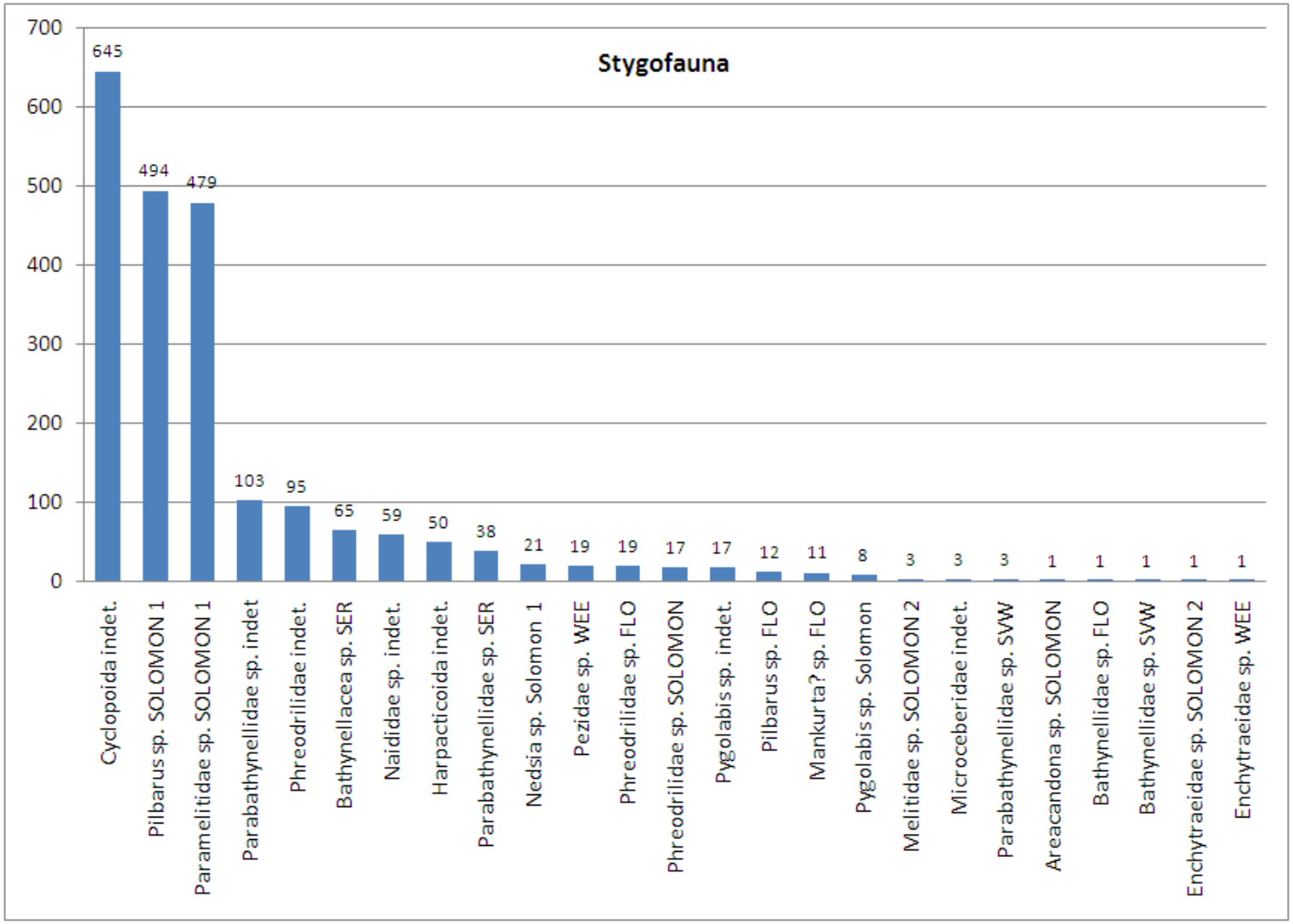


Figure 4 **Abundance histogram of stygofauna species collected from Solomon Regional sites.**

Table 3 **Stygofauna species collected from Solomon Kings project area: Genetic and morphological alignments with Regional specimens and genetic alignments with species from wider Pilbara. Numbers indicate total individuals collected.**

STYGOFAUNA	KINGS	REGIONAL	Recorded Outside impact	Details
Amphipods				
Melitidae sp. SOLOMON 2	1	3	Yes	
Nedsia sp. Solomon 1	21	21	Yes	Morphologically = Regional specimens
Paramelitidae sp. SOLOMON 1	273	479	Yes	Confirmed by DNA
Pilbarus sp. SOLOMON 1	38	494	Yes	
Copepods				
Australocamptus `pilbarensis`	3	695	Yes	All copepods collected from Kings were identified by specialist taxonomist as belonging to widespread taxa. The Regional survey collected 695 Copepod specimens which were not further identified to species level.
Diacyclops cockingi	343		Yes	
Diacyclops humphreysi	1382		Yes	
Diacyclops scanloni	97		Yes	
Diacyclops sobeprolatus	235		Yes	
Elaphoidella humphreysi	36		Yes	
Orbuscyclops westaustraliensis	25		Yes	
Parastenocaris cf jane	2		Yes	
Schizopera cf. Roberiverensis	3		Yes	
Thermocyclops aberrans	313		Yes	
Crustaceans				
Bathynellidae sp. SOLOMON 1	5		No	Genetically different from Regional and other Pilbara species.
Parabathynellidae sp. SOLOMON	6		No	
Isopods				
Pygolabis sp. Solomon	21	8	Yes	Genetically = Regional and other Pilbara species.
Oligochaetes				
Enchytraeidae sp. SOLOMON 1	15		No	Genetically ≠ Regional and other Pilbara species
Enchytraeidae sp. SOLOMON 2	1	1	Yes	Genetically = Regional species
Naididae sp. SOLOMON	3		No	Genetically ≠ other Pilbara species
Phreodrilidae sp. SOLOMON	6	17	Yes	Genetically = Regional and other Pilbara species
Ostracods				
Areacandona sp. SOLOMON	3	1	Yes	Genetically = Regional species
Total stygofauna species recorded from Solomon Kings project area: 22 Number of species found outside of potential impact: 18				

3.3 TROGLOFAUNA

Fourteen species of troglofauna were collected from 11 Regional sampling sites. All but one troglofauna species were collected in low abundance, with one or two individuals collected per species (Figure 5, Table 4).

The fourteen species collected from Regional areas included characteristic Pilbara troglofauna groups such as beetles (4 species), centipedes (2 species), cockroaches (1 species), pincushion millipedes (1 species), pseudoscorpions (1 species), silverfish (1 species), spiders (1 species), sucking bugs (1 species), bristletails (1 species) and whipscorpions (1 species).

Species relevant to the impact assessment from the Regional Survey for the Kings deposits are presented in Table 4, while the complete list of troglofauna species recorded is presented in APPENDIX C.

Five (possibly 6) of the 14 species of troglofauna recorded from the Regional Survey were previously recorded from the Kings deposits (Subterranean Ecology 2010). No troglofauna species found in the Regional Survey aligned with specimens previously recorded from the Firetail deposits (cf. Bennelongia 2010).

Of a total 27 species recorded from potential impact areas at Kings, ten species (36%) have been collected outside of impact areas. Seventeen species of troglofauna have not yet been recorded outside of potential impact areas at Kings (Table 4). At least nine troglofauna species (provisionally 19 species pending further taxonomic study) are shared between the Kings and Firetail areas, suggesting habitat connectivity between the Kings and Firetail deposits.

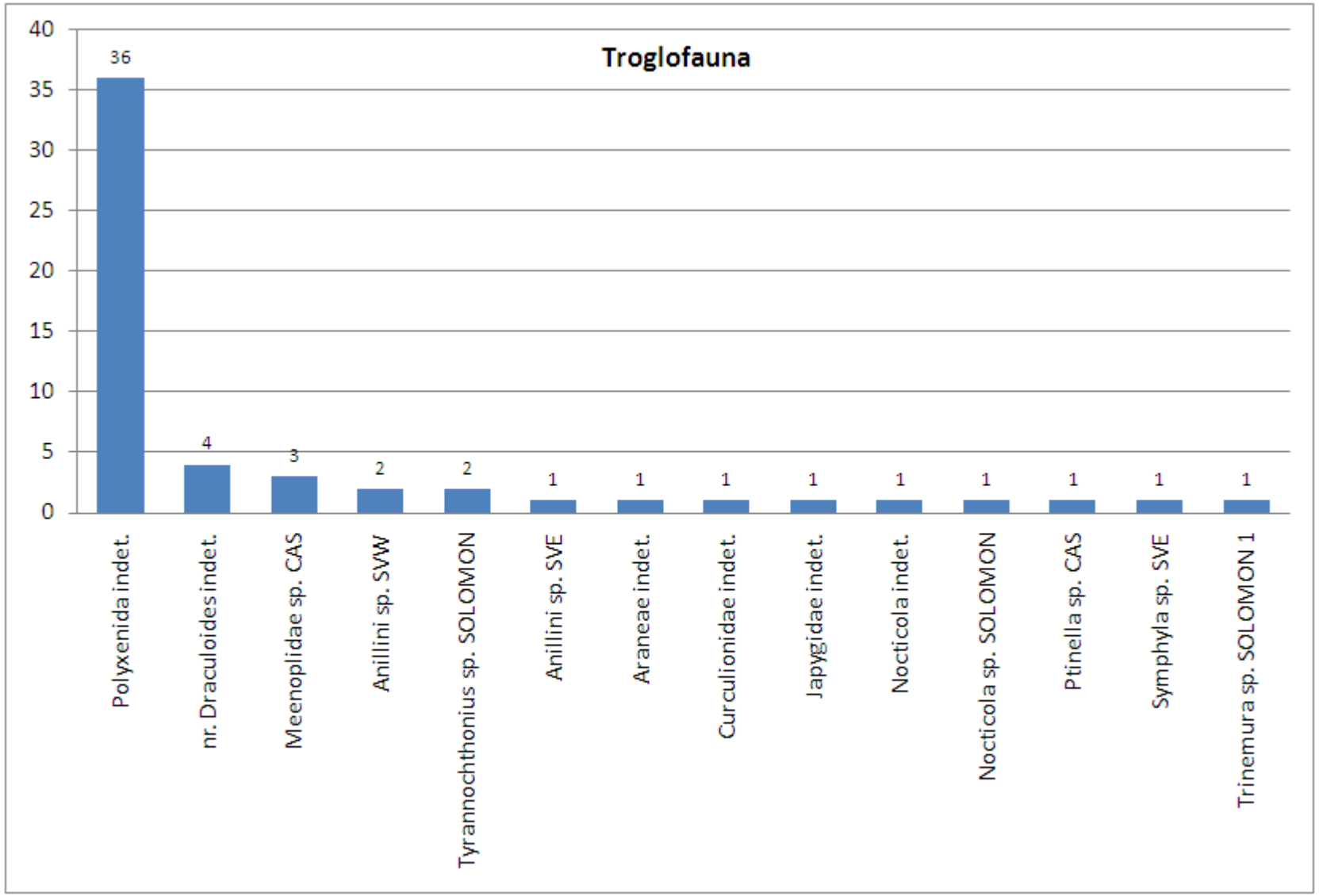


Figure 5Abundance histogram of troglofauna species collected in the Solomon Regional survey (data as per 6 January 2011).

Table 4 **Troglofauna species collected from Solomon Kings project area: Genetic and morphological alignments with Regional specimens, morphological alignments with Firetail specimens and genetic alignments with species from wider Pilbara. Table only showing Regional and Firetail species in common with King's species. Numbers indicate total individuals collected. (Appendix C for full species list).**

TROGLOFAUNA	KINGS	REGIONAL	FIRETAIL	Outside impact	Details
Beetles					
Anillini sp. SOLOMON 1	1			No	Genetically ≠ Regional species
Anillini sp. SOLOMON 2	2		24	Yes	Morphologically = Firetail specimens outside impact
Curculionidae sp. SOLOMON 1	18			No	Genetically ≠ other Pilbara species
Curculionidae sp. SOLOMON 2	2		1	No	Morphologically = Firetail specimens inside impact
Zuphiini sp. SOLOMON	1			No	No matching specimens found outside impact to date.
Myriapods					
Cryptops sp. SOLOMON 1	1			No	Genetically ≠ other Pilbara species
Cryptops sp. SOLOMON 2	1			No	Genetically ≠ other Pilbara species
Pauropoda sp. SOLOMON	3			No	No matching specimens found outside impact to date.
Scolopendridae sp. SOLOMON	1		5	Yes	Morphologically = Firetail specimens outside impact
Polyxenida sp. SOLOMON	22	36		Yes	Genetically = widespread Pilbara species
Symphyla sp. SOLOMON	1			No	Genetically ≠ Regional and other Pilbara species
Symphyla sp. SVE		1			
Cockroaches					
Nocticola sp. SOLOMON	37	1		Yes	Genetically = widespread Pilbara species
Isopods					
Trogloarmadillo sp. SOLOMON	2			No	Genetically ≠ other Pilbara species
Microwhip scorpion	1				
Palpigradi sp. SOLOMON	1			No	No matching specimens found outside impact to date.
Pseudoscorpions					
Indohya sp. SOLOMON	2		2	Yes	Morphologically = Firetail specimens outside impact
Tyrannochthonius sp. SOLOMON	3	2	1	Yes	Morphologically = Regional species = sp. B5
Silverfish					
Trinemura sp. SOLOMON 1	1	1	?	Yes	Genetically = Regional species = sp. B8?
Trinemura sp. SOLOMON 2	1			No	Genetically ≠ Regional species
Spiders					
Anapistula sp. SOLOMON	8		11	Yes	Morphologically = Firetail specimens outside impact
Sucking bugs					
Meenoplidae sp. SOLOMON 1A	1			No	Genetically ≠ Regional species

TROGLOFAUNA	KINGS	REGIONAL	FIRETAIL	Outside impact	Details
Meenoplidae sp. SOLOMON 1B	1			No	Genetically ≠ Regional species
Two-pronged Bristletails					
Japygidae sp. SOLOMON 1	1	?		No	Genetically ≠ other Pilbara species
Japygidae sp. SOLOMON 2	1	?	1	No	= sp. B15?, Genetically ≠ other Pilbara species
Japygidae sp. Indet.		1			
Parajapygidae sp. SOLOMON 1	1			No	No matching specimens found outside impact to date.
Parajapygidae sp. SOLOMON 2	1		1	No	= sp. B10, No matching specimens found outside impact to date.
Whipscorpions					
nr. *Draculoides* sp. SOLOMON1	19		23	Yes	Morphologically = Firetail specimens outside impact
nr. *Draculoides* sp. SOLOMON2	3		5	Yes	Morphologically = Firetail specimens outside impact

Total troglofauna species recorded from Solomon Kings project area: 27
Number of species found outside of potential impact: 10

4 DISCUSSION

4.1 STYGOFAUNA

The majority (82%) of stygofauna species recorded previously from the Kings deposits are now known to occur in Regional areas or in the wider Pilbara. Subterranean fauna sampling often results in the detection by chance of certain species which are rare or difficult to detect (e.g. singletons or species found only at one bore). These chance detections may occur inside or outside of impact areas. The current data from the Regional Survey indicates that the majority of the stygofauna assemblage found at Kings ranges outside of the impact areas. The similar geology and hydrological settings of the Regional reference areas with the Kings deposits indicates potential connectivity of habitat, or similar habitat supporting a similar stygofauna assemblage. There is currently no reason to suggest locally-restricted distribution ranges for the remaining four species in the stygofauna assemblage that have not yet been detected outside of impact areas at Kings. This does not exclude the possibility that some of these species may not be found outside of impact areas.

At the current time the following stygofauna species have not yet been detected outside of impact areas at Kings:

- Bathynellidae sp. SOLOMON 1
- Parabathynellidae sp. SOLOMON
- Enchytraeidae sp. SOLOMON 1
- Naididae sp. SOLOMON

Regarding what is known about the ecology of these groups relevant to their potential distribution ranges;

- Most groundwater oligochaetes in Western Australia appear to have fairly widespread distributions, although taxonomic and distribution knowledge is limited for some groups, including enchytraeids. Pinder (2008) recorded several species of Pilbara phreodrilids with widespread trans-basin distributions, in addition to some species known only from restricted localities to date. Oligochaetes might be expected to have greater subterranean dispersal capacities owing to their small size, vermiform shape and burrowing capabilities. Enchytraeid oligochaetes are known to include terrestrial, aquatic, and amphibious species in the Pilbara (Pinder *et al.* 2010);
- While the taxonomy of bathynellids is poorly described, multiple species of parabathynellids have been described from calcrete aquifers in the Yilgarn region and other aquifers in the Kimberley (Cho *et al*. 2005, 2006a,b) (Guzik *et al.* 2008) and most of these appear to be range-restricted. A review by Bennelongia (2008) indicated that species of Bathynellidae and Parabathynellidae have very small ranges with two-thirds of species having a known range of less than 10 km.

4.2 TROGLOFAUNA

Fourteen troglofauna species were recorded from the Regional reference areas, four of which were previously known from the Kings deposits; these four species represent 15% of the total 27 troglofauna species known from Kings. Morphological and/or DNA alignments confirmed that 11 troglofauna species recorded from Kings were also recorded at Firetail, representing 40% of the 27 species recorded from Kings (APPENDIX C). The combined results indicate that a proportion of the troglofauna diversity from Kings is now known to occur more widely in the local or sub-regional area.

In the Firetail deposits, 45 species of troglofauna were identified with ten species recorded only from within the Firetail or Kings impact areas. Although these ten species have not been recorded outside of the impact areas, it is unlikely that their distribution is restricted to these areas due to the high level of geological connectivity (Bennelongia 2010).

All of the taxa represent undescribed species, and members of groups frequently recorded in subterranean habitats in the Pilbara region (Subterranean Ecology unpub. data). Some of these taxa, such as *Trinemura* (G. Smith pers. comm.), Japygidae and Parajapygidae (A. Sendra pers. comm.), and Pauropoda, are typical soil dwelling forms, and may not be true troglobites.

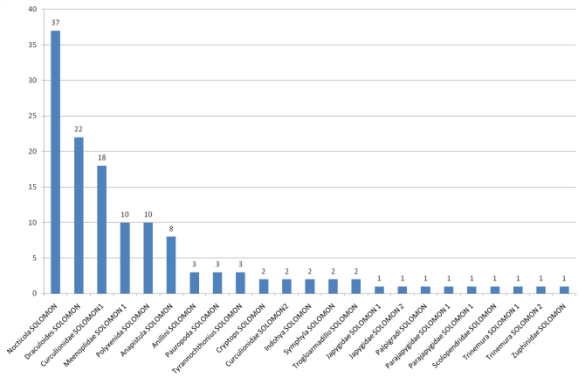
In the case of Meenoplidae (troglophilic or trogloxenic forms) and Polyxenida, genetic studies have revealed the occurrence of widespread species in the Pilbara and Yilgarn regions (Subterranean Ecology unpub. data).

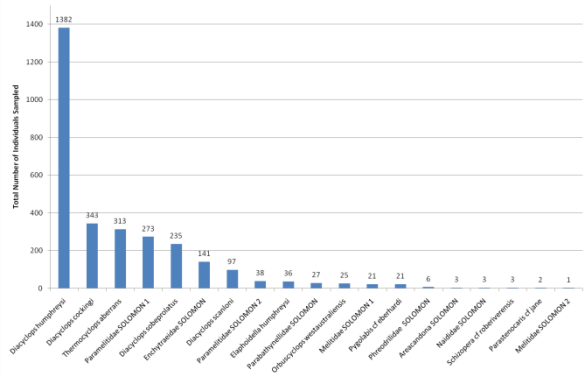
Other taxonomic groups, such as Zuphiini (P.M. Giachino pers. comm.), *Tyrannochthonius* and *Indohya* ((Edward and Harvey 2008; Harvey and Volschenk 2007), Palpigradi (Barranco and Harvey 2008), *Troglarmadillo* (S. Taiti pers. comm.), and *Cryptops* (Subterranean Ecology unpub. data) are generally considered troglobitic. It might be expected that the potential distribution of these species coincides with the extent of continuous geologic habitat.

Different species may have slightly different habitat requirements which may influence their distribution, and the possibility of some range restricted species cannot be discounted, however, the occurrence of shared species at Kings, Firetail and the Regional reference areas indicates that a proportion of the troglofauna assemblage is locally or sub-regionally widespread, and there is habitat connectivity across CID, DID and BIF substrates in impact areas and out-of-impact areas.

Invertebrate ecological communities typically comprise a few species that are abundant and a majority of species occurring in low numbers. Pilbara subterranean communities are no exception to this general natural pattern. The majority of troglofauna species recorded from Kings, Firetail and Regional survey sites were collected in low numbers, with 70% of species represented by one or two individuals. This is often the case during troglofauna sampling (Subterranean Ecology 2007), and is a factor which necessitates a great deal of sampling to overcome. The abundance histograms for the Kings Baseline Subterranean Fauna Survey illustrates this pattern clearly, with most species known from only from one, two, or three specimens (see graphs below).

Kings Baseline Troglofauna (left) and Stygofauna (right)





For subterranean fauna surveys, this means it is difficult to detect most of the rare species in a community, and almost impossible to collect all species in the course of one or even several surveys. In the case of follow-up surveys, it is also difficult to re-collect the rare species. The average number of troglofauna caught during the Regional Survey was 0.39 per sample, a lower capture success than the Baseline Surveys at Kings (0.80) and Firetail (1.27) (Subterranean Ecology 2010; Bennelongia 2010), but still well within other typical capture rates for the Pilbara (Subterranean Ecology 2007).

Despite this practical limitation, the Solomon Regional Subterranean Fauna Survey re-collected 82% of stygofauna species and 36% of troglofauna species recorded during the Kings Baseline Survey. Considering the inherent rarity of most species, and the practical sampling difficulties involved with subterranean fauna surveys, the Solomon Regional Survey had a reasonable recapture success rate.

Factors limiting the capture success during the Solomon Baseline Subterranean Fauna Survey were:

1. Absence of any bore holes available for sampling as reference sites in the CID at Valley of Queens, Trinity, Valley of Kings, Zion;
2. Access to suitable sampling sites – eg. drill holes in similar CID geology at Serenity were limited;
3. CID Deposits at Sheila Valley are smaller and more fragmented than at Kings;
4. BIF and DID deposits (at Sheila Valley and Castle Camp) may provide less optimum habitat for subterranean fauna than CID.
5. Season – The October-December regional survey timing was not optimum survey season for troglofauna which is typically late wet season.

4.3 CONCLUDING REMARKS

The Regional Survey has provided valuable regional context for the assessment of stygofauna and troglofauna in relation to the Solomon Project Kings deposits. On the basis of previous data, the PER for the Solomon Project predicted that the subterranean fauna habitat at Kings "does not appear isolated from the surrounding geology" (Fortescue 2010), and that it was unlikely that the species detected were restricted to potential impact areas.

The interim results from the Solomon Regional Survey support this prediction, providing evidence that the majority (82%) of stygofauna species and a considerable proportion of troglofauna species (36%) detected from Kings occur at other sites throughout the sub-regional area. The results to date suggest that subterranean habitats at Kings and Firetail are connected, with potential subsurface connections also to reference areas outside of impact zones.

The Baseline Surveys at Kings and Firetail recorded relatively high proportions of shared species between deposits (Subterranean Ecology 2010; Bennelongia 2010). Of the 45 troglofauna species recorded at Firetail, 16 species were common to both Firetail North and Firetail South (36%), while at Kings, 48% of troglofauna species were common over two or more deposits (Valley of Queens, Trinity, Valley of Kings, Zion). At least nine troglofauna species (provisionally 19 species pending further taxonomic study) are shared between the Kings and Firetail areas, indicating habitat connectivity between the differing geologies of Channel Iron Deposit (CID), Detrital Iron Deposit (DID) and Banded Iron Formation (BIF).

To date, nine troglofauna species from Firetail are known only from inside potential impact areas and 17 are only known from potential impact areas in Kings. Only four stygofauna species recorded from inside potential impact areas in Kings have not yet been recorded outside of impact, but considering that the majority of the Kings stygofauna assemblage is known from outside impact it is considered likely that these four species also occur outside.

The regional results support the conclusion made in the Solomon Baseline Subterranean Fauna Survey (Subterranean Ecology 2010), that, it is probable that species of subterranean fauna collected in the Kings CID palaeochannel deposits will also be found to occur outside the proposed mine impact zones, in suitable porous geological strata and connected hydrologic catchments. Nonetheless, the possible existence of locally restricted SRE species cannot be discounted, but determining the distribution range of all potential SRE species will be difficult owing to practical limitations in sampling.

The proportion of troglofauna currently only known from inside the proposed Kings mine prospects (62%) is relatively high compared with the proposed Firetail mine pits (9%), and other developments where approval to mine has been obtained (eg. 4 to 25%) (Bennelongia 2010). The high disparity in proportions at Kings is clearly related to the absence of any reference sites available for sampling in the CID at Valley of Queens, Trinity, Valley of Kings, Zion. At these deposits the proposed mine plan involves complete removal of the CID. At Firetail, in contrast, numerous bores located outside of the proposed pits were available for sampling thus enabling similar numbers of impact (144) and reference (119) samples to be collected (Bennelongia 2010

5 REFERENCES

Barranco, P., and M. S. Harvey. 2008. The first indigenous palpigrade from Australia: a new species of *Eukoenenia* (Palpigradi: Eukoeneniidae). Invertebrate Systematics 22:227-233.

Bennelongia (2008) Risk Assessment for Bathynellidae at the Central West Coal Project. Prepared for Aviva Corporation Ltd by Bennelongia Pty Ltd November 2008 Report 2008/54

Bennelongia. 2010. Troglofauna Assessment for the Solomon Project: Firetail Deposits. Prepared for Fortescue Metals Group Ltd by Bennelongia Pty Ltd. Pp. 34, Perth.

Cho, J.-L., Park, J.-G. & Humphreys, W.F. (2005) A new genus and six species of the Parabathynellidae (Bathynellacea, Syncarida) from the Kimberley region, Western Australia. Journal of Natural History, 39, 2225-2255.

Cho, J.-L., Humphreys, W.F. & Lee, S.-D. (2006a) Phylogenetic relationships within the genus Atopobathynella Schminke (Bathynellacea : Parabathynellidae). Invertebrate Systematics, 20, 9-41.

Cho, J.-L., Park, J.-G. & Reddy, Y.R. (2006b) *Brevisomabathynella* gen. nov. with two new species from Western Australia (Bathynellacea, Syncarida): the first definite evidence of predation in Parabathynellidae. *Zootaxa,* **1247,** 25-42. Cho et al. 2005, 2006a,b

Christiansen, K. A. 1992. Biological processes in space and time: cave life in the light of modern evolutionary theory. Pp. 453-478 *in* A. I. Camacho, ed. The natural history of biospeleology. Monografias Museo Nacional de Ciencias Naturales, Graficas Mar-Car, Spain.

Christiansen, K. A. 2005. Morphological adaptations. Pp. 386-396 *in* D. C. Culver, and W. B. White, eds. Encyclopaedia of Caves. Elsevier.

Eberhard, S. M., S. A. Halse, and W. F. Humphreys. 2005. Stygofauna in the Pilbara region, north-west Western Australia: a review. Journal of the Royal Society of Western Australia 88:167-176.

Eberhard, S. M., S. A. Halse, M. D. Scanlon, J. S. Cocking, and H. J. Barron. 2004. Assessment and conservation of aquatic life in the subsurface of the Pilbara region, Western Australia. Pp. 61-68 *in* J. Gibert, ed. World Subterranean Biodiversity, Proceedings of an International Symposium, 8th - 10th December 2004, Villeurbanne, France. University Claude Bernard of Lyon 1, PASCALIS European Research programme.

Eberhard, S. M., S. A. Halse, M. Williams, M. D. Scanlon, J. S. Cocking, and H. J. Barron. 2009. Exploring the relationship between sampling efficiency and short range endemism for groundwater fauna in the Pilbara region, Western Australia. Freshwater Biology 54:885-901.

Edward, K. L., and M. S. Harvey. 2008. Short-range endemism in hypogean environments: the pseudoscorpion genera *Tyrannochthonius* and *Lagynochthonius* (Pseudoscorpiones: Chthoniidae) in the semiarid zone of Western Australia. Invertebrate Systematics 22:259-293.

Envronmental Protection Authority (EPA). 2003. Guidance for the assessment of environmental factors: Consideration of subterranean fauna in groundwater and caves during environmental impact assessment in Western Australia. Guidance Statement No. 54. www.epa.wa.gov.au. Pp. 1-12. Environmental Protection Authority, Government of Western Australia, Perth.

EPA. 2007. Sampling methods and survey considerations for subterranean fauna in Western Australia (Technical Appendix to Guidance Statement No. 54). Guidance Statement 54A (Draft). Environmental Protection Authority, Perth.:32.

Finston, T., M. S. Johnson, S. M. Eberhard, J. Cocking, J. McRae, S. Halse, and B. Knott. 2008. Molecular evidence for a taxonomic revision of paramelitid amphipods from aquifers in the Pilbara. Records of the Western Australian Museum 24:395-410.

Finston, T. L. J., M.S. Humphreys, W.F., Eberhard, S.M., Halse, S. 2006. Cryptic speciation in two widespread subterranean amphipod genera reflects historical drainage patterns in an ancient landscape. Molecular Ecology 16:355-365.

Fortescue Metals Group. 2010. Solomon Project Public Environmental Review.

Gibert, J., D. L. Danielopol, and J. A. Stanford, eds. 1994. Groundwater ecology. Academic Press, San Diego.

Guzik, M. T., K. M. Abrams, S. J. B. Cooper, W. F. Humphreys, J.-L. Cho, and A. D. Austin. 2008. Phylogeography of the ancient Parabathynellidae (Crustacea : Bathynellacea) from the Yilgarn region of Western Australia. Invertebrate Systematics 22:205-216.

Hahn, H. J., and D. Matzke. 2005. A comparison of stygofauna communities inside and outside groundwater bores. Limnologica 35:31-44.

Harvey, M. 2002. Short-range endemism among the Australian fauna: some examples from non-marine environments. Invertebrate Systematics 16: 555-570.

Harvey, M. S., O. Berry, K. L. Edward, and G. Humphreys. 2008. Molecular and morphological systematics of hypogean schizomids (Schizomida: Hubbardiidae) in semiarid Australia. Invertebrate Systematics 22:167-194.

Harvey, M. S., and E. S. Volschenk. 2007. Systematics of the Gondwanan pseudoscorpion family Hyidae (Pseudoscorpiones: Neobisioidea): new data and a revised phylogenetic hypothesis Invertebrate Systematics 21:365-406.

Holsinger, J. R. 2000. Ecological derivation, colonization, and speciation. Pp. 399-415 *in* H. Wilkens, D. C. Culver, and W. F. Humphreys, eds. Ecosystems of the world Vol. 30 - Subterranean ecosystems. Elsevier, Amsterdam.

Howarth, F. G. 1983. Ecology of cave arthropods. Annual Review of Entomology 28:365-389.

Humphreys, W. F. 2000. Background and Glossary. Pp. 3-14 *in* H. Wilkens, D. C. Culver, and W. F. Humphreys, eds. Ecosystems of the World 30: Subterranean Ecosystems. Elsevier Science, Amsterdam.

Humphreys, W. F. 2008. Rising from Down Under: developments in subterranean biodiversity in Australia from a groundwater fauna perspective. Invertebrate Systematics 22:85-101.

Karanovic, I. 2007. Candoninae Ostracodes from the Pilbara Region in Western Australia. Crustaceana Monographs 7:1-432.

Page, T. J., W. F. Humphreys, and J. M. Huges. 2008. Shrimps down under: evolutionary relationships of subterranean crustaceans from Western Australia (Decapoda: Atyidae: Stygiocaris). Plos ONE 3:e1618.

Pinder, A. (2008) The distribution of phreodrilid oligochaetes (Clitellata: Annelida: Phreodrilidae) in north-western Australia with descriptions of two new species. Records of the Western Australian Museum 24: 459–468.

Pinder, A., A. S. Halse, J. R. Shiel, and J. McRae. 2010. An arid zone awash with diversity: patterns in the distribution of aquatic invertebrates in the Pilbara region on Western Australia. Records of the Australian Museum 78:205-246.

Ponder, W., and D. J. Colgan. 2002. What makes a narrow-range taxon? Insights from Australian freshwater snails. Invertebrate Systematics 16:571-582.

Poulson, T. L., and K. H. Lavoie. 2000. The trophic basis of subsurface ecosystems. Pp. 231-250 *in* H. Wilkens, D. C. Culver, and W. F. Humphreys, eds. Ecosystems of the world Vol. 30 - Subterranean ecosystems. Elsevier, Amsterdam.

Subterranean Ecology. 2010. Fortescue Metals Group Solomon Project: Kings Deposits Subterranean Fauna Survey & Assessment. Pp. 92.

Sungwon, J. H., and J.-L. Cho. 2009. Three new species of Billibathynella from Western Australia (Crustacea, Syncarida, Parabathynellidae). Journal of Naural History 43:2365 - 2390.

Thorne, A. M., I. M. Tyler, J. G. Blockley, and D. F. Blight. 1996. Mount Bruce, W.A. Sheet SF 50-11 (2nd edition): Western Australia Geological Survey, 1:250 000 Geological Series.

Volschenk, E. S., and L. Prendini. 2008. Aops oncodactylus, gen. et sp. nov., the first troglobitic urodacid (Urodacidae: Scorpiones), with a re-assessment of cavernicolous, troglobitic and troglomorphic scorpions. Invertebrate Systematics 22:235-257.

APPENDICES

APPENDIX A SURVEY SITE LOCATIONS AND SAMPLING METHODS USED

Site Code	UTM N	UTM E	FIELD TRIP 1			FIELD TRIP 2				
	Zone 50 - GDA94		Scrape / Haul [1]	Pump [2]	Karaman [2]	Troglofauna Traps [3]		Scrape / Haul [1]	Pump [2]	Karaman [2]
						# Traps	Trap Depth			
CASTLE CAMP										
SM3817	7543635	584367	1			1	28m	1		
SM4096	7543699	586001	1			3	23m, 18m, 13m	1		
SM4097	7543785	585982	1			3	25m, 20m, 15m	1		
SM4098	7543907	585994	1			3	28m, 23m, 18m	1		
SM4099	7544090	586000	1			3	30m, 27m, 25m	1		
SM4100	7544207	586026	1							
SM4101	7544313	586053	1			3	38m, 34m, 31m	1		
SM4102	7544538	586025	1			3	20m, 15m, 12m	1		
SM4103	7544051	586120	1			3	28m, 23m, 18m	1		
KANGEENAREENA CREEK										
Kangeenareena spring	7555268	590524			1					1
MT FLORANCE PASTORAL STATION										
Cappers well	7559929	603116		1					1	
Deep well	7551674	605616		1					1	
Outcamp well	7560996	607957		1					1	
Pigeon Well Bore	7563380	609303	1					1		
Tripod well	7556039	608648		1					1	
SERENITY										
Kerrigan bore	7547728	553003	1							
Phil bore	7540990	552896		1						
SOM036	7547202	552591	1							
SOM045	7549000	553960						1		
SOM049	7551410	554600						1		
SOM052	7547907	552996	1							
SOM053	7552200	555100						1		
SHEILA VALLEY EAST										
Al's bore	7542555	571178		1						
SMB1012 pi	7544547	572599	1							
SMB1012 pr	7544533	572608	1							

Site Code	UTM N	UTM E	FIELD TRIP 1			FIELD TRIP 2				
	Zone 50 - GDA94		Scrape / Haul [1]	Pump [2]	Karaman [2]	Troglofauna Traps [3]		Scrape / Haul [1]	Pump [2]	Karaman [2]
						# Traps	Trap Depth			
SV0163	7544311	572995	1			1	28m			
SV0164	7544520	573017	1			1	25m			
SV0171	7543428	575392				1	32m			
SV0172	7543612	575394	1			3	54m, 49m, 54m			
SV0173	7543833	575404				1	22m			
SV0267	7544855	572570	1			1	16m	1		
SV0268	7545102	572642	1			1	20m	1		
SV0293	7543399	575010	1			1	24m	1		
SV0306	7541702	572998						1		
SV0310	7541838	572806						1		
SV0312	7542190	572599						1		
SV0313	7542301	572610						1		
SV0432	7543406	575006	1			1	20m	1		
SV0581	7542303	571606						1		
SV0582	7542393	571608						1		
SV0583	7542512	571602						1		
SV0586	7542052	571991						1		
SV0666	7543712	575397	1			3	48m, 43m, 38m	1		
SV0667	7543500	575406	1			1	25m	1		
SV0668	7543315	575381	1			1	46m	1		
SV0672	7543551	575028	1			1	20m	1		
SV0689	7544373	573063	1			1	27m	1		
SV0691	7545011	572593	1			1	18m	1		
SV0693	7544608	572601	1			1	15m	1		
SHEILA VALLEY WEST										
L64.7 m	7538603	567391	1							
Mt Sheila N bore	7538875	568995	1							
Mt Sheila S bore	7538866	569017	1					1		
SV0136	7538916	567005	1			1	20m	1		
SV0137	7538700	566997	1			1	20m	1		
SV0138	7538479	566999	1			1	20m	1		
SV0139	7538596	566995	1			1	26m	1		

Site Code	UTM N	UTM E	FIELD TRIP 1			FIELD TRIP 2				
	Zone 50 - GDA94		Scrape / Haul [1]	Pump [2]	Karaman [2]	Troglofauna Traps [3]		Scrape / Haul [1]	Pump [2]	Karaman [2]
						# Traps	Trap Depth			
SV0140	7538785	567001	1			1	21m	1		
SV0333	7538298	567396	1			1	28m	1		
SV0334	7538401	567395	1			1	29m	1		
SV0335	7538497	567419	1			1	32m	1		
SV0336	7538582	567419				1	5m	1		
SV0442	7539987	566595	1			1	20m	1		
SV0443	7539802	566598	1			1	31m	1		
SV0444	7539590	566603	1			1	34m	1		
SV0445	7539387	566616	1			1	34m	1		
SV0448	7538828	566622	1			1	24m	1		
WEELAMURRA CREEK										
2 Mile bore	7537916	575037		1					1	
Macca's bore	7551629	574785	1					1		
TRRDR3	7544858	571344	1							
WARP19	7562873	569373	1							
WARP19 (B)	7562873	569380	1							
Weelamurra spring	7556232	572763			1					1

1 = Sampling method captures both troglofauna and stygofauna

2 = Sampling method captures only stygofauna

3 = Sampling method captures only troglofauna

APPENDIX B ALIGNMENT OF STYGOFAUNA TAXA COLLECTED FROM KINGS AND REGIONAL SURVEYS

Numbers indicate presence (1) or absence (blank)

STYGOFAUNA	Solomon Kings Deposits [1]				Solomon Regional Survey [2]							Recorded outside Solomon potential impact	Details
	TRI	VoK	VoQ	ZIO	CAS	FLO	KAN	SER	SVE	SVW	WEE		
Melitidae sp. SOLOMON 2		1*				1*						Yes	
Nedsia sp. Solomon 1	1	1*	1*								1*	Yes	Morphological alignment with Regional specimimens. Confirmed by DNA reports.
Paramelitidae sp. SOLOMON 1	1	1*	1*		1	1^	1	1	1*	1	1^	Yes	
Pilbarus sp. SOLOMON 1	1		1*			1	1		1	1^	1*	Yes	
Pilbarus sp. FLO						1*						Yes	Recorded from Regional sites only.
Copepoda indet.	1												
Cyclopoida indet.			1		1	1	1	1	1	1	1		
Harpacticoida indet.					1	1	1			1	1		
Australocamptus 'pilbarensis'		1	1									Yes	
Diacyclops cockingi	1		1									Yes	
Diacyclops humphreysi	1	1	1									Yes	All copepods collected from Kings were identified morphologically by specialist taxonomist as belonging to widespread taxa. Identification to species level of copepods collected from Regional survey (Copepoda indet., Cyclopoida indet. and Harpacticoida indet.) is No.
Diacyclops scanloni	1	1										Yes	
Diacyclops sobeprolatus	1	1	1									Yes	
Elaphoidella humphreysi	1	1										Yes	
Orbuscyclops westaustraliensis	1											Yes	
Parastenocaris cf jane		1										Yes	
Schizopera cf. Roberiverensis			1									Yes	
Thermocyclops aberrans	1		1									Yes	
Mangkurta? sp. FLO						1						Yes	Recorded from Regional sites only.
Bathynellidae sp. SOLOMON 1			1*									No	Genetically different from Regional and other sequenced Pilbara species.
Bathynellidae sp. FLO						1*						Yes	Recorded from Regional sites only.
Bathynellacea sp. SER								1				Yes	Recorded from Regional sites only.
Bathynellidae sp. SVW										1		Yes	Recorded from Regional sites only.
Parabathynellidae sp. indet.		1	1					1		1			Morphologically cryptic species: Need DNA analysis to identify.
Parabathynellidae sp. SOLOMON		1*										No	Genetically different from Regional and other sequenced Pilbara species.
Parabathynellidae sp. SVW										1*		Yes	Recorded from Regional sites only. Genetically different from Kings species.
Parabathynellidae sp. SER								1*				Yes	Recorded from Regional sites only. Genetically different from Kings species.
Microceberidae sp. indet.						1						Yes	Recorded from Regional sites only.
Pygolabis sp. indet.					1		1^				1	Yes	Recorded from Regional sites only.

STYGOFAUNA	Solomon Kings Deposits [1]				Solomon Regional Survey [2]							Recorded outside Solomon potential impact	Details
	TRI	VoK	VoQ	ZIO	CAS	FLO	KAN	SER	SVE	SVW	WEE		
Pygolabis sp. SOLOMON	1	1	1*								1*	Yes	Genetically similar to Regional and to widespread Pilbara species.
Enchytraeidae sp. SOLOMON	1	1	1	1									Morphologically cryptic species: Need DNA analysis to identify.
Enchytraeidae sp. SOLOMON 1			1*									No	Genetically different from Regional and widespread Pilbara species.
Enchytraeidae sp. SOLOMON 2				1*	1*							Yes	Identified from DNA as same species as recorded in Castle Camp.
Enchytraeidae sp. WEE											1*	Yes	Recorded from Regional sites only.
Phreodrillidae sp. indet.						1	1			1	1^		Morphologically cryptic: DNA analysis needed to identify.
Phreodrilidae sp. SOLOMON	1	1*								1*		Yes	Identified from DNA as same as Regional and widespread Pilbara species
Phreodrilidae sp. FLO						1*						Yes	Recorded from Regional sites only.
Naididae sp. indet.							1				1	Yes	Recorded from Regional sites only.
Naididae sp. SOLOMON	1		1*									No	Genetically different from other Pilbara species.
Ostracoda sp. indet.					1	1	1				1	Yes	Recorded from Regional sites only.
Areacandona sp. SOLOMON			1*								1*	Yes	DNA analysis indicates same species Kings and Regional.
Pezidae sp. WEE											1	Yes	Recorded from Regional sites only.

Footnotes to Appendix B

1 = Solomon Kings Deposits: TRI = Trinity; VoK = Valley of the Kings; VoQ = Valley of the Queens; ZIO = Zion
2 = Regional Areas: CAS = Castle Camp; FLO = Mt Florance; KAN = Kangeenareena Creek; SER = Serenity; SVE = Sheila Valley East; SVW = Sheila Valley West; WEE = Weelumarra Creek
* = Sample sent for DNA analysis: Results received.
^ = Sample sent for DNA analysis but failed to sequence